being too worn, than were kept, and soon we had to pick our steps as the ground began to give beneath us, and we saw the pools covered with the white blossoms of the water-lilies. Edging towards the wood where the ground was firmer, we soon lost all but a stray *C. tiphon*, but swarms of *Epinephele janira* and *Enodia hyperanthus* were put up at every step, the last-named particularly abundant. One of the most abundant species here was *Ematurga atomaria*, a fairly large and interesting form; equally abundant was *Eubolia mensuraria*, and occasionally one flushed *Acidalia immutata* in first-class condition. Occasional specimens of *Argynnis aglaia* flew across the bog or settled on the flowers, and *Melitaea dictynna* was not uncommon, but altogether over. The two Anthroceras noticed in the wood were more abundant, and some of the *A. trifolii* had almost the facies of *A. palustris*, the lowland marsh species, whilst the six-spotted species, which so much resembles *A. filipendulae*, and may be *A. stephensi* (*hippocrepidis*, Stphs.), must have the genitalia examined to make certain of the species. The *A. trifolii* are especially interesting, a few examples with a faint red abdominal ring=ab. *ruficincta*, and other interesting examples, but we obtained too few, and most of these in poor condition, to write really critical notes thereon. Two or three *Adscita statices* were also captured, but the species was going over.

(*To be continued*).

Notes on the Life-History of Nepticula acetosæ, Stt. (*with plate*).

By ALFRED SICH, F.E.S.

On August 15th, 1908, I was walking over the short turf in Richmond Park, quite away from any trees, when I accidentally came on a colony of *Nepticula acetosae*. They were in all stages from the ovum to the full-grown larva, and the opportunity thus afforded of making some notes on the larval habits seemed too good to be thrown away. A supply of ova and larvæ was gathered, and some imagines were bred at the end of August.

A second supply of ova was taken, September 7th, in the same locality. It will be remembered that this species is the smallest British moth, and that Mr. Shield first discovered the insect in October, 1852, near Dublin. Since that time it has occurred in several places both here and on the continent. We have, in Britain, two species of dock, which are known by the name of sorrel, *Rumex acetosa*, L., the sorrel, and *Rumex acetosella*, L., the sheep-sorrel. They appear to be very closely allied, and *Nepticula acetosae* attacks both species. The mines in both sorrels are similar, except that very often the narrowness of the leaf of *R. acetosella* compels the larva to make the first part of the mine oblong rather than circular in contour. Stainton (*Nat. His. Tin.*, i., p. 236) lays some stress on the fact that the food-plant of this *Nepticula* is *Rumex acetosa*, but, later, Tutt (*Brit. Lep.*, i., p. 53) gives the food-plant as *R. acetosella*. Both authors are right, as the larva feeds in either species of sorrel, but if there be any preference in the matter, then I think it lies with *R. acetosa*. From the great difference in the leaves of the larger docks, such as *R. obtusifolius*, *R. sanguineus*, etc., compared with those of the smaller sorrels, it seems unlikely that *N. acetosae* would mine in them, but Stainton says (*loc.cit.*, p. 230) that Wing did find mines in a leaf of dock, though he does not mention

which species of dock. It is, however, clear that he meant one of the larger species.

The ovum.—The comparatively very large egg is laid almost always on the underside of the leaf and usually away from the midrib and from the margin. Several eggs may be laid on the same leaf, but always separately. The largest number I have seen is twenty, on a leaf of *R. acetosa*. There were twelve on one side of the midrib and eight on the other, all laid on the underside. On another leaf there were nine eggs, seven of which were laid on the upperside, which is however, quite the exception. Before being laid, I imagine, the egg is ovoid. The shell is evidently very soft, as after the egg is laid it is found to be very wide and flat, as though it had been poured on to the leaf in a molten state. It takes the exact impression of that portion of the leaf on which it lies. This causes its outline to become very irregular and often much indented, and also greatly adds to the difficulty of detecting the micropyle, a feat I have not yet accomplished. If one could persuade the moth to lay on glass, the micropyle could, no doubt, be made out. In outline, the egg is ovoid, or even subtriangular rather than circular. There is a long axis which measures 0·38mm., and a shorter measuring 0·27mm. Of course the ova vary a little in size, but the smallest measured 0·32mm. by 0·23mm. They are very flat but vary in height, and I think 0·06mm. would about give the average height. There is no visible sculpture on the surface of the shell. When newly-laid the ova are colourless and transparent, but as the larva advances in growth its yellow colour shows through the shell, generally first appearing as a yellow line, running partly round the boundaries of the egg. A certain time before hatching, the larva can be seen lying in a curved position within the egg. The head is partly buried under the last portion of the abdomen, and there is an orange-coloured streak in the centre of the alimentary canal. Just before hatching the orange streak becomes concentrated, and, while the larva is eating its way into the leaf, it travels up to the anus and is eventually expelled. When the larva of *Phyllocnistis suffusella* eats its way out of the egg-shell into the leaf, its action is very vigorous, and within two hours it will be hidden in the leaf. *Nepticula acetosae* is a great contrast with this, as its movements, when eating its way through the base of the egg-shell into the leaf, are exceedingly gentle. It has, however, much harder work to do than the other, which simply severs the cuticle of the leaf from the upper cells of the parenchyma, while the Nepticulid tunnels into the parenchyma and consumes the more solid portion, as well as the juice. One larva, which I noted more particularly, began to penetrate the leaf at 4.20 p.m. By 6.20 p.m. it had worked about half its head into the leaf. At 10 p.m. it had nearly withdrawn the thorax from the egg-shell. When I again saw it, the next morning, it had already left the egg-shell, and at 1 p.m. it was lying just under the upper cuticle of the leaf. At the least, the larva requires twelve hours to get clear of the egg-shell. On examining the forsaken shell we see that, where the larval head lay, there is a semi-circular hole in the cuticle of the leaf and a line of excrement, this running round the shell where the body of the larva lay, and ending in a little patch of orange. The egg-shell remains for weeks attached to the leaf, and may be noted as a silvery-grey flat speck in the centre of the circular part of even quite old mines. Under a lens it appears much

wrinkled, and will always serve to indicate the origin of any disturbance caused by *N. acetosae* in sorrel leaves, even if the discoloration of the leaf be not more than 1mm. in diameter.

The larval habits.—When leaving the egg the larva does not mine directly to the upper-surface of the leaf, but works its way through the parenchyma in a gradually ascending curve, completing perhaps two-thirds of a circle before reaching the upper cuticle. After once reaching the upper cuticle the larva continues mining just beneath it until full-fed, when, like most other Nepticulids, it quits the mine to pupate. Throughout the four stadia which it passes in the mine, it always mines venter uppermost. When the larva in the first instar reaches the upper surface of the leaf it continues the mine in ever-widening circles, and, having made two circles or two-and-a-half, it lies up for its first ecdysis. The mined patch at this stage measures 1¼mm. in diameter, and is usually red, except where the two very irregular circles of fine black excrement lie. The gallery of the mine itself is rather wide in comparison with the larva, of a pale grey colour, with an irregular, often interrupted, line of black excrement, which lies sometimes in the centre of the gallery, and sometimes along one of the sides. The length of the gallery mined during the first stadium is about 4mm. The larva is exceedingly delicate, and it requires some care when extracting it from the mine. It is pale ochreous, with a somewhat swollen thorax, in which the small head is almost buried. It is quite helpless when out of the mine. The duration of the first stadium in some cases I noted as four-and-a-half days, but no doubt in warm weather this time would be much shortened, as the larva I took from the mine when seven days old was already in the third instar. As with many of these minute larvæ, the change of skin takes place rapidly, especially in the earlier stages. One example in the first instar had been feeding well certainly on the morning of September 17th, but, at midnight it was lying up for the change, and when I saw it again about 1 p.m. on the 18th, it was feeding vigorously, having in the meantime cast off its skin. The larva in the second instar is bright yellow, though when newly-changed it still shows the colour of the first instar. It reaches to the length of 1·2mm. Its mode of life continues the same, and the mine does not alter in character, though it is a little wider, and the black excremental track more distinct. I have no notes as to the duration of either the second or the third stadium, but if we find a mine about 2mm. in diameter, and especially if it has one pale half-circle outside the red blotch, we may safely conclude that the larva inside is in the third instar. When taken from the mine it is almost as helpless as in the first instar, bright yellow in colour, and about 1¾mm. in length. It differs chiefly from the second instar in size, and the body is more cylindrical, whilst the 9th and 10th abdominal segments are longer and narrower in proportion, thus approaching the appearance of these segments in the last instar.

Its method of feeding is much the same, but it eats out the parenchyma to a greater depth, especially shortly before lying up for the last larval change. This is seen by the last half or three-quarters of the circle in the blotch-like part of the mine being nearly as transparent as the later serpentine portion of the mine. While still in the first rather narrow pale circle the larva usually lies up for the third moult. In the first three instars *Nepticula acetosae* exhibits a delicate,

inactive larva without locomotive organs, for the thoracic pads do not seem capable of progressive action when the larva is out of the mine. There are no visible setæ, and the only movements the body seems capable of, are lateral, the head and thorax can be moved from side to side, at least in the third instar. In the fourth (and last) instar, however, instead of the helpless larva, we find quite an active little caterpillar, provided with its due quota of setæ and a number of leg-like organs, by which it can make fairly rapid progress, and, besides this, it is endowed with a set of muscles which enables it to accomplish at least one gymnastic feat. This great difference between the third and fourth instars probably accounts for the longer period of time occupied during the third ecdysis, which, in some cases, lasted over 24 hours, and though I have no precise note on this point, I think the period is generally longer. Owing to the very thick cell walls of the sorrel leaf it is difficult, if not impossible, to observe the larva changing its skin, but I imagine it is like other Nepticulids in this respect and pushes the old head aside, then continues feeding till it is out of the old skin. On three occasions when I took larvæ in the fourth instar out of the mines, I found the head of the third instar adhering to the 8th or 9th abdominal segment. The larvæ, probably, in their progress, had brushed the old head along with them. By the way, by the above remarks I do not mean to say that the larva, even after having assumed the fourth instar some hours, is capable of the activity I mention, for this is gradually developed as the larva comes to maturity. Having entered on the fourth stadium, the larva usually mines one circle round its home before, as Stainton says, "it flies off at a tangent into an irregular tortuous gallery" (*Ins. Brit. Tin.*, p. 303). The gallery is now greenish, or sometimes pinkish-white, about 1mm. in width, with a rather thick, irregular, and often interrupted, line of dark excrement, sometimes running down the centre and sometimes down the side of the gallery. The course of this part of the mine is somewhat dependent on the leaf in which it is situated. If there be ample space, the larva will make two or three rather sharp turns in the leaf, above the earlier part of the mine, that is, towards the apex of the leaf, and then one bold sweep before the end. If, on the contrary, the leaf be very narrow or much occupied by other mines of *N. acetosae*, the larva has to feed where it can find a vacant space, and the mine in consequence becomes very irregular. In one much eaten leaf, now before me, the larva has made two turns above the red part of the mine and then gone as closely as possible along the margin of the leaf, right round the apex to the opposite side, without making any deviation at all. More often the larva has to work its way with many turnings in order to avoid those parts of the leaf already eaten or occupied by its companions in the same leaf. I may say here that the larvæ seem to be of a remarkably gentle disposition, as in crowded leaves I have noticed them running side by side for some distance, in practically the same mine, without showing any signs of hostility, just as we sometimes see the larvæ of *Chrysopora hermannella* mining in couples in the leaves of *Chenopodium*. I have never attempted to ascertain the sexes of individuals thus running in double harness. To return to that portion of the mine made after the larva breaks away from the blotch-like part, though fairly even in width it is variable in length, depending possibly mainly on the nourishment afforded by the

particular leaf, or condition of the leaf, in which the mine is situated. In one case where the larva was free to continue in circles round the earlier mine the tangential portion, if one may for distinction sake so term it, was only 7mm. long, but the same portion of a mine in a leaf rather crowded with mines, measured 19mm. The larva in the fourth instar, when seen in the mine, appears of a beautiful yellow, with a broad green stripe running down the centre of the body. When viewed under a strong lens it has a peculiar appearance. The larvæ of most species of the genus *Nepticula* can be plainly seen in their respective mines, but not so that of *N. acetosae*. Owing to the very strong cell walls of the cuticle of the sorrel leaves the outline of the larva can only be guessed at, though its colours are plainly visible. It reminds one of a beautiful yellow and green stained-glass window. When fullfed the larva, sometimes at once, but more often, I think, after some delay, bites a semi-circular slit through the upper cuticle of the leaf and works its way out of the mine. The larva mines venter uppermost, and, therefore, comes out on its back. When nearly free of the mine its throws its head over its back, and, thus rolled almost in a ring, falls to the ground among the herbage.

(*To be concluded.*)

The Genius Apion; Notes from Sussex.

By HEREWARD C. DOLLMAN, F.E.S.

The varied and profuse flora of Ditchling, and surrounding downland, induced me this August to give my attention to the Apions. The result has, I think, repaid the investigation, close upon fifty species having been captured. Some of the records are of particular interest, inasmuch as they refer to unusual foodplants.

The "subulate group" proved to be but poorly represented, perhaps August is late for such species as *Apion subulatum* and *A. craccae*. *A. pomonae* occurred sparingly on *Lathyrus*. Three species of the "squamose" group were taken, the common *A. ulicis* on *Ulex*, *A. genistae* locally common on both of the species of *Genista*, and the recently-introduced *A. kiesenwetteri* also on *Genista*. The latter species was only found on Ditchling Common, and, although it was not rare, yet good examples were few and far between, as the insect is very soon abraded. For the detection of *A. kiesenwetteri* in the field, I owe my thanks entirely to Mr. H. St. J. Donisthorpe. *A. urticarium* was swept in small numbers off *Urtica dioica* at Alfriston; it was very local indeed.

Most of the yellow-red-legged species were to the fore, *A. rufirostre*, *A. viciae*, *A. difforme* (two examples taken off *Hypericum quadrangulum*), and *A. varipes* were common. I took some sixteen examples of the latter species off *Lathyrus pratensis*, a pabulum not recorded for it before. *A. apricans*, *A. trifolii*, *A. bohemani*, *A. dichroum*, and *A. nigritarse* were all common.

By sweeping *Matricaria*, both *A. confluens* and *A. hookeri* were freely taken, the latter often in very great abundance. *A. aeneum*, *A. radiolus*, *A. carduorum*, and *A. onopordi*, of course proved themselves not to be rarities; I found *A. onopordi* not uncommonly on *Arctium lappa*. Working thyme yielded *A. ricinum* (very rare), and also *A. atomarium*; this little *Apion* was very prolific. *A. virens* and *A. pisi*